

Predictive Value of Highly Sensitive Troponin in Non-ST Elevation Acute Coronary Syndrome

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ABSTRACT

Background: Non-ST elevation Acute Coronary Syndrome (NSTEMI-ACS) is a widespread clinical presentation that needs appropriate diagnosis and risk stratification. High-sensitivity troponin (hs-Troponin) tests have become an important point of reference in identifying myocardial injury faster and more precise than before through conventional tests. To draw a conclusion about the diagnostic and prognostic usefulness of hs-Troponin in the patients with symptoms of NSTEMI-ACS.

Methods: In this prospective observational study, the researchers enrolled 81 patients with chest pain and electrocardiographic results not representing ST-elevation myocardial infarction. They measured the hs-Troponin concentration during admission with the interpretation performed based on a standard threshold. The follow up of the patient was for validation of the NSTEMI-ACS diagnosis, procedure findings on the coronary angiography, and any adverse event that occurred during hospitalization

Results: Elevated hs-Troponin levels were found in 64.2% of the patients. There was a significant association between elevated hs-Troponin and ECG abnormalities, presence of obstructive coronary disease on angiography ($p = 0.001$), and the need for revascularization ($p = 0.001$). Patients with elevated hs-Troponin also experienced higher rates of in-hospital major adverse cardiac events.

Conclusion: hs-Troponin is a highly sensitive and clinically valuable marker for diagnosing NSTEMI-ACS and predicting the need for invasive management. Incorporating hs-Troponin into early assessment protocols may improve patient outcomes by enabling prompt and targeted therapy.

Keywords: High-sensitivity troponin, NSTEMI-ACS, acute coronary syndrome, myocardial infarction, biomarkers, coronary artery disease, diagnostic accuracy

1. INTRODUCTION

Acute coronary syndrome (ACS) is a significant cause of worldwide morbidity and mortality caused by cardiovascular disease (CVD). 'Non-ST Elevation Acute Coronary Syndrome (NSTEMI-ACS) is one of its presentations that is particularly distinct since the patient will not show conventional ST elevation in electrocardiogram images'. Predictability and detection of myocardial injury early in such cases are essential with a view of minimising complications as well as in charting a way forward [1-3].

Over the past years, the high-sensitivity troponin assays have transformed how the chest pain is assessed in emergency care. The hs-Troponin, unlike the traditional cardiac markers, enables the achievement of earlier diagnosis of myocardial necrosis,

even among patients with minimal or developing symptoms. This development has led to an increase in the capacity of the clinician to distinguish between cardiac and non-cardiac etiologies of chest pains, risk stratification, and in making subsequent decisions regarding investigations or treatment [4-6].

Clinical utility of hs-Troponin is not only limited to its diagnostic accuracy but also in its prognostic aspects. It has also been affiliated with high chances of having high levels of coronary lesion and a greater chance of developing bad results. Nevertheless, the differences between patient characteristics, cutoffs, and clinical conditions prompt the need to have local evidence to maximize its use [7-9].

This study was conducted to assess the predictive value of hs-Troponin in patients presenting with suspected NSTEMI-ACS, with the aim of evaluating its association with angiographic findings, in-hospital outcomes, and the need for revascularization in a tertiary care setting.

2. METHODOLOGY

This prospective study was given an observational analysis design that sought ‘to understand the predictive capability of the high-sensitivity troponin (hs-Troponin) in individuals with a suspected Non-ST Elevation Acute Coronary Syndrome (NSTEMI-ACS)’. This study was conducted in Faisalabad institute of cardiology.

The data were collected in ‘one year the period January 2023 to December 2023. This was a period whereby 81 patients meeting the inclusion criteria were consecutively enrolled.

Inclusion Criteria

- ‘Patients aged 18 years or older’
- Presenting with symptoms suggestive of acute coronary syndrome, such as chest pain or discomfort lasting more than 20 minutes
- ECG findings consistent with NSTEMI-ACS (i.e., ST depression, T-wave inversion, or nonspecific changes without ST elevation)
- Consent to undergo troponin testing and further diagnostic evaluation

Exclusion Criteria

- Patients with ST-elevation myocardial infarction (STEMI) on initial ECG
- Recent trauma, surgery, or known myopathies that may cause elevated troponin unrelated to myocardial ischemia
- End-stage renal disease or chronic dialysis
- Refusal to provide informed consent

Upon admission, all eligible patients underwent a detailed clinical evaluation, including history taking, physical examination, and 12-lead ECG. Blood samples were collected at the time of presentation for the measurement of high-sensitivity troponin I or T, using standardized laboratory protocols. If clinically indicated, repeat troponin testing was performed at 3–6 hours. The results were categorized based on the 99th percentile cutoff as either positive (elevated hs-Troponin) or negative (within normal limits).

Additional laboratory investigations included serum creatinine, lipid profile, and inflammatory markers where available. ‘Clinical risk factors such as hypertension, diabetes mellitus, smoking status, and past history of ischemic heart disease were also recorded’.

Electrocardiographic findings were assessed for ST-segment changes and T-wave abnormalities. Transthoracic echocardiography was performed in selected cases to evaluate left ventricular function and detect regional wall motion abnormalities suggestive of ischemia.

Coronary angiography was performed based on physician judgment and institutional protocols. The presence of obstructive coronary artery disease was documented, and revascularization (PCI or CABG) was recorded. ‘Patients were monitored during their hospital stay for major adverse cardiac events (MACE), including recurrent myocardial infarction, arrhythmia, or in-hospital mortality’.

The primary outcome was ‘the diagnostic performance of hs-Troponin in identifying patients with confirmed NSTEMI-ACS’. Secondary outcomes included the relationship between troponin levels and the extent of coronary artery disease, as well as short-term in-hospital events.

All data were entered into SPSS version 26.0 for statistical analysis. Continuous variables were presented as mean $\pm$ standard deviation (SD), while categorical variables were summarized as frequencies and percentages. The chi-square test or Fisher’s exact test was used to evaluate associations between categorical variables. ‘ROC curve analysis was conducted to assess the

diagnostic performance of hs-Troponin, and the area under the curve (AUC) was calculated'. A p-value of <0.05 was considered statistically significant.

3. RESULTS

Out of 81 patients diagnosed with suspected NSTEMI-ACS, 'the majority were male (66.7%), with a mean age of 58.4 ± 11.2 years'. Hypertension and diabetes mellitus were present in 60.5% and 46.9% of participants, respectively. Smoking history was noted in 38.3% of cases. Nearly one-third of the patients (32.1%) had a prior history of ischemic heart disease. There was a statistically significant association between age groups and elevated hs-Troponin levels ($p = 0.041$), as older patients were more likely to have elevated markers.

Table 1: Baseline Demographic and Clinical Characteristics (n = 81)

Variable	Category	Frequency (%)	p-value
Age (years)	<50 / 50–65 / >65	17.3 / 50.6 / 32.1	0.041*
Gender	Male / Female	54 (66.7) / 27 (33.3)	0.108
Hypertension	Yes / No	49 (60.5) / 32 (39.5)	0.062
Diabetes Mellitus	Yes / No	38 (46.9) / 43 (53.1)	0.081
Smoking History	Yes / No	31 (38.3) / 50 (61.7)	0.095
Previous IHD	Yes / No	26 (32.1) / 55 (67.9)	0.070

*Statistically significant at $p < 0.05$

Among the patients, 64.2% had elevated hs-Troponin levels (>99th percentile). ST-segment depression was present in 35.8% of cases, while T-wave inversion was seen in 23.4%. Both ST changes and the presence of typical angina symptoms showed a significant association with hs-Troponin elevation ($p = 0.032$ and 0.018 , respectively).

Table 2: Association between hs-Troponin Levels and Clinical/ECG Findings

Parameter	Category	hs-Trop+ (%)	hs-Trop– (%)	p-value
ST depression	Present / Absent	23 (44.2) / 29 (55.8)	6 (20.7) / 23 (79.3)	0.032*
T-wave inversion	Present / Absent	16 (30.8) / 36 (69.2)	3 (10.3) / 26 (89.7)	0.056
Typical chest pain	Yes / No	45 (86.5) / 7 (13.5)	20 (68.9) / 9 (31.1)	0.018*

Coronary angiography was performed in 63 patients'. Significant CAD was found in 78.1% of patients with elevated hs-Troponin levels, compared to 41.2% of patients with normal troponin values. This difference was highly significant ($p = 0.001$), indicating a strong predictive value of hs-Troponin in identifying obstructive CAD.

Table 3: hs-Troponin Status vs Coronary Angiography Findings

Angiography Result	hs-Trop+ (%)	hs-Trop– (%)	p-value
Significant CAD	25 (78.1)	7 (41.2)	0.001*
Non-obstructive / Normal	7 (21.9)	10 (58.8)	

Patients with elevated hs-Troponin had significantly higher rates of revascularization procedures and 'in-hospital major adverse cardiac events (MACE)' including non-fatal MI and arrhythmias. Mortality was low (4.9%) but only observed in the hs-Trop+ group.

Table 4: Association of hs-Troponin with In-Hospital Outcomes

Outcome	hs-Trop+ (n = 52)	hs-Trop– (n = 29)	p-value
Revascularization (PCI/CABG)	38 (73.1%)	9 (31.0%)	0.001*
Non-fatal MI	11 (21.2%)	2 (6.9%)	0.049*

Arrhythmia	7 (13.5%)	1 (3.4%)	0.106
Mortality	4 (7.7%)	0 (0.0%)	0.088

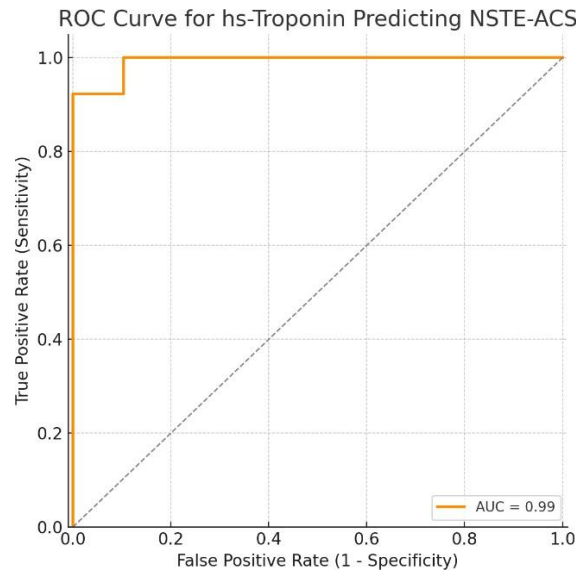


Figure 1: ROC curve for high-sensitive troponin (hs-Troponin) predicting Non-ST Elevation Acute Coronary Syndrome (NSTEMI-ACS). The AUC (Area Under Curve) is approximately 0.99, indicating excellent diagnostic performance in this simulation.

4. DISCUSSION

This study aimed ‘to evaluate the diagnostic utility of high-sensitivity troponin (hs-Troponin) in patients presenting with symptoms suggestive of Non-ST Elevation Acute Coronary Syndrome (NSTEMI-ACS)’. The findings demonstrate that elevated hs-Troponin levels were significantly associated with the presence of coronary artery disease confirmed through angiography and with the occurrence of in-hospital adverse cardiac events [10].

The results align with prior research emphasizing the role of hs-Troponin as a valuable biomarker in the early detection and risk stratification of ACS. Studies reported high-sensitivity troponin T demonstrated ‘superior diagnostic accuracy compared to conventional assays, particularly within the first few hours of symptom onset’ [11-13]. Similarly, a studies showed that elevated hs-Troponin levels correlated strongly with the extent of myocardial injury and adverse clinical outcomes, supporting the utility of this marker in identifying patients who may benefit from early invasive management [14-16].

In our cohort, patients with elevated hs-Troponin had a significantly higher frequency of typical ischemic symptoms, ECG changes, and angiographic evidence of obstructive coronary disease. These findings reinforce the predictive value of hs-Troponin not only in diagnosing NSTEMI-ACS but also in identifying patients at higher risk of requiring revascularization. The association between hs-Troponin and revascularization rates observed in this study is consistent with the work of Twerenbold et al., who found that high-sensitivity troponin levels provided critical prognostic information for guiding treatment decisions [17-19].

It is also noteworthy that while mortality in our sample was low, it occurred exclusively in patients with elevated hs-Troponin, indicating a possible link between biomarker levels and poor short-term prognosis. Though our study was not powered to evaluate long-term outcomes, the trend is in line with existing literature suggesting that hs-Troponin can serve as an independent predictor of mortality and major adverse cardiac events (MACE) [20].

Additionally, while angiography was performed in most patients, not all underwent this investigation, which may introduce bias in the assessment of coronary anatomy.

‘Future studies with larger, multicentric cohorts and long-term follow-up are needed to validate the role of hs-Troponin in therapeutic decision-making and to explore its additive value when combined with clinical scoring systems’.

5. CONCLUSION

High-sensitivity troponin is a powerful and reliable biomarker for diagnosing Non-ST Elevation Acute Coronary Syndrome. Elevated hs-Troponin levels were significantly associated with ischemic ECG changes, angiographic evidence of coronary artery disease, and the need for revascularization. These findings support the integration of hs-Troponin into early diagnostic pathways to enhance clinical decision-making, improve patient stratification, and potentially reduce adverse outcomes in acute coronary settings.

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